

WHAT IS CLAIMED IS:

1
1 1. A telephone with an IACK keypad defining both combination key regions and
2 independent key regions arranged in alternating columns, wherein columns of combination
3 key regions include

4 multiple numerical columns together including numerical regions corresponding to
5 numerals 0 through 9, with each numerical column containing a plurality of said numerical
6 regions, and

7 at least one other column containing key regions corresponding to punctuation
8 symbols.

1 2. The telephone of claim 1 with three numerical columns.

1 3. The telephone of claim 2 wherein the numerical columns together form a
2 standard telephone key layout, with a left numerical column containing 1,4,7, a middle
3 numerical column containing 2,5,8,0, and a right numerical column containing 3,6,9.

1 4. The telephone of claim 1 wherein the key regions are defined by
2 corresponding sensible features on an exposed surface of a flexible membrane.

1 5. The telephone of claim 4 wherein the sensible features comprise changes in
2 elevation across the surface of the membrane.

1 6. The telephone of claim 5 wherein the independent key regions are spaced
2 apart with a spacing of no more than about one-half of a human finger tip width.

1 7. The telephone of claim 1 wherein the numerical key regions are visibly larger
2 than the key regions corresponding to punctuation symbols.

1 8. The telephone of claim 1 wherein the independent key regions and the
2 combination key regions are of different size.

1 9. The telephone of claim 1 wherein the independent key regions together
2 include regions corresponding to letters of an alphabet.

1 10. The telephone of claim 1 wherein each key region carries an associated,
2 visible legend.

1 11. The telephone of claim 1 wherein the numerical columns have a visibly
2 different coloration than said one other column.

1 12. The telephone of claim 1 wherein the combination key regions are arranged in
2 columns of alternating width.

1 13. The telephone of claim 1 wherein the independent key regions are arranged in
2 six vertical columns, as determined by key legend orientation.

1 14. The telephone of claim 13 wherein the independent key regions are arranged
2 in first, third, fifth, seventh, ninth and eleventh vertical columns and comprise regions
3 corresponding to letters, the numerical combination key region columns forming second,
4 sixth and tenth vertical columns, and fourth and eighth vertical columns including key
5 regions corresponding to punctuation symbols, with column numbering progressing from
6 either lateral side of the keypad.

1 15. The telephone of claim 1 configured to register different punctuation symbols
2 as one of the key regions corresponding to punctuation symbols is actuated twice in
3 succession.

1 16. An IACK keypad comprising a cover with an exposed surface defining both
2 combination key regions and independent key regions arranged in alternating columns, with
3 the independent key regions comprising nubs elevated above the combination key regions,
4 the exposed surface forming a continuous, smooth contour between adjacent independent key

5 regions, void of delineations marking shared boundaries between adjacent independent key
6 grid spaces of an underlying key space grid.

1 17. The IACK keypad of claim 16 wherein the nubs are diamond-shaped, with
2 corners directed between adjacent combination key regions.

1 18. The IACK keypad of claim 16 wherein the continuous, smooth contour
2 between adjacent independent key regions carries visible legends corresponding to the
3 combination key regions.

1 19. An IACK keypad defining both combination key regions and independent key
2 regions arranged in alternating columns and having a standard orientation defined by legends
3 associated with the independent and combination key regions, wherein
4 the alternating columns are disposed along lines canted at an angle with respect to the
5 standard orientation of the keypad.

1 20. The IACK keypad of claim 19 wherein said angle is about 45 degrees.

1 21. A touch-sensitive input device comprising
2 an exposed, continuous surface defining a planar area; and
3 a grid of sense elements coextensive with the area of the exposed surface and
4 responsive to engagement of the exposed surface by an operator to establish a position of
5 said engagement on the exposed surface;
6 wherein the exposed surface varies in elevation across its planar area to form a series
7 of tactile features.

1 22. The input device of claim 21 wherein the tactile features comprise elevated
2 nubs.

1 23. The input device of claim 22 wherein said elevated nubs extend at least about
2 0.75 millimeter from adjacent regions of the exposed surface.

1 24. The input device of claim 22 wherein said surface carries legends associated
2 with said tactile features.

1 25. The input device of claim 21 wherein said tactile features define distinct
2 regions of the surface corresponding with associated alphanumeric characters.

1 26. The input device of claim 25 configured to output a sequence of
2 alphanumeric characters as corresponding tactile features of the surface are engaged
3 sequentially.

1 27. The input device of claim 21 comprising an IACK keypad.

1 28. The input device of claim 27 wherein the tactile features comprise nubs
2 defining independent key regions of the IACK keypad.

1 29. The input device of claim 27, further comprising an electronic circuit adapted
2 to temporarily display alphanumeric characters on a screen as an operator traverses the
3 exposed surface, the displayed alphanumeric characters selected to correspond to a position
4 of engagement of the exposed surface by the operator.

1 30. An electronic device comprising
2 an IACK keypad having an exposed, continuous surface defining both independent
3 key regions and combination key regions;
4 a grid of sense elements underlying the surface of the keypad and responsive to
5 motion of a human finger across the surface of the keypad; and
6 an electronic circuit adapted to receive signals from the IACK keypad indicative of
7 keypad status and to produce an output in response to keypad actuation by an operator;
8 wherein the electronic circuit is configured to determine an intended combination key
9 input based at least in part upon a sensed position of a finger between centers of adjacent
10 independent key regions.

1 31. The electronic device of claim 30, further comprising a key switch matrix
2 responsive to engagement of independent key regions, wherein the electronic circuit is
3 configured to determine intended combination key input based on both the sensed finger
4 position and a state of the key switch matrix.

1 32. The electronic device of claim 31, wherein the grid of sense elements and the
2 key switch matrix share some conductive traces of a printed circuit board.

1 33. The electronic device of claim 30 wherein the grid of sense elements defines a
2 grid spacing wider than a spacing between centers of adjacent independent key regions.

1 34. An electronic device comprising
2 a substrate carrying a first array of spaced apart, conductive trace elements;
3 a flexible cover disposed above the substrate and carrying a second array of spaced
4 apart, conductive trace elements, said first and second arrays together forming a coordinate
5 system, the cover separated from the substrate by an array of resilient, collapsible elements
6 and having an exposed, continuous surface;
7 the first and second arrays of trace elements forming a capacitive grid responsive to
8 presence of a digit of an operator on the surface of the cover; and
9 an electronic circuit adapted to sense a capacitive state of the grid and to determine a
10 position of said digit upon the sensed capacitive state.

1 35. The electronic device of claim 34 wherein said continuous surface defines key
2 regions of a keypad; and wherein said electronic circuit interprets an intended keypad input
3 based at least in part upon the sensed capacitive state.

1 36. The electronic device of claim 34 wherein the capacitive grid is responsive to
2 a position of local deflection of the cover toward the substrate.

1 37. The electronic device of claim 34 wherein the second array of trace elements
2 is disposed on a surface of the cover closest the substrate.

1 38. The electronic device of claim 34 in the form of an IACK keypad, with the
2 exposed cover surface defining both independent key regions and combination key regions.

1 39. The electronic device of claim 34 wherein the collapsible elements comprise
2 formations integrally molded to extend from a surface of the cover facing the substrate.

1 40. A keypad comprising
2 an outer cover with an exposed, continuous surface defining key regions;
3 a grid of sense elements underlying the surface of the cover and responsive to
4 position of a human finger on the surface of the keypad; and
5 a single switch adapted to change state when any one of a multiplicity of the key
6 regions is pressed.

1 41. The keypad of claim 40 wherein the single switch is adapted to change state
2 when any key region of the keypad is depressed.

1 42. The keypad of claim 40 in the form of an IACK keypad, with the exposed
2 cover surface defining both independent key regions and combination key regions, the single
3 switch adapted to change state when any independent key region is depressed.

1 43. The keypad of claim 42 wherein the independent key regions are elevated
2 above the combination key regions.

1 44. A telephone comprising
2 a keypad defining alpha key regions corresponding to individual letters, and
3 numerical key regions corresponding to individual numerals; and
4 an electronic circuit connected to the keypad to receive input therefrom as various
5 key regions are engaged by an operator;
6 wherein the electronic circuit is configured to translate alpha key input into numerical
7 output in the form of a combination of numerals 2 through 9, based upon standard telephone
8 keypad letter-number correspondence.

1 45. The telephone of claim 44 wherein the electronic circuit is configured to, in a
2 first mode, display an individual letter in response to engagement of a selected alpha key
3 region, and to, in a second mode, display one of numerals 2 through 9 in response to
4 engagement of the selected alpha key region, the displayed numeral selected according to
5 standard telephone keypad letter-number correspondence.

1 46. The telephone of claim 44 wherein the electronic circuit is configured to
2 register a sequence of letters as their associated alpha key regions are engaged; and,
3 in response to additional input from the operator, transpose the registered sequence of
4 letters into a telephone number according to standard telephone keypad letter-number
5 correspondence.

1 47. The telephone of claim 46 wherein the electronic circuit is further adapted to,
2 in response to said additional input, initiate a telephone call using the telephone number.

1 48. The telephone of claim 44 wherein the electronic circuit is adapted to register
2 numerical output according to the numerals associated with the numerical key regions.

1 49. A method of dialing a telephone, the method comprising entering a desired
2 sequence of alphanumeric characters including at least one alpha character, the telephone
3 generating a corresponding sequence of numerals by transposing the alpha character into one
4 of the numerals 2 through 9 according to standard telephone keypad letter-number
5 correspondence.

1 50. The method of claim 49 further including instructing the telephone to generate
2 the corresponding sequence of numerals after the alphanumeric sequence has been entered.

1 51. The method of claim 49 wherein the desired sequence of alphanumeric
2 characters is entered on a keypad including at least 24 individual key regions, each key
3 region corresponding to a different alphabet letter.

1 52. The method of claim 49 wherein the desired sequence of alphanumeric
2 characters is in the form of a pronounceable utterance and entered by pronouncing the
3 utterance.

1 53. The method of claim 49 wherein the sequence of alphanumeric characters
2 includes a series of alpha characters.

1 54. The method of claim 53 wherein the series of alpha characters spells a
2 pronounceable text.

1 55. An IACK keypad comprising
2 a substrate carrying an array of sense elements arranged to change state in response to
3 keypad operation;
4 a flexible cover disposed above the substrate and having an exposed surface defining
5 an array of independent key regions, with combination key regions defined in interstices
6 between adjacent independent key regions; and
7 an array of discrete snap elements extending between the cover and the substrate and
8 spacing the cover from the substrate, the snap elements each located between two adjacent
9 independent key regions and adapted to resiliently collapse as a non-linear response to local
10 pressure against the exposed cover surface to provide tactile feedback of keypad operation.

1 56. The IACK keypad of claim 55 wherein the snap elements are located under
2 the combination key regions.

1 57. The IACK keypad of claim 55 wherein the snap elements are located between
2 directly adjacent independent key regions.

1 58. The IACK keypad of claim 55 wherein the snap elements include snap
2 elements located under the combination key regions and snap elements located directly
3 between directly adjacent independent key regions.

1 59. The IACK keypad of claim 55 wherein each independent key region and each
2 combination key grid space has four corresponding, spaced-apart snap elements disposed at
3 its periphery, with each interstice between four adjacent snap elements corresponding to a
4 key region.

1 60. The IACK keypad of claim 59 wherein the snap elements are each located
2 equidistant between centers of adjacent independent key regions and equidistant between
3 centers of adjacent combination key regions.

1 61. The IACK keypad of claim 60 wherein each independent key region defines
2 an exposed contact pressure area, the keypad further comprising an array of conductive pills
3 between the substrate and cover, each conductive pill centered below a corresponding
4 independent key region and extending laterally farther than the contact pressure area of its
5 associated independent key region.

1 62. The IACK keypad of claim 61 wherein each conductive pill extends laterally
2 farther toward an adjacent combination key region than the contact pressure area of its
3 associated independent key region.

1 63. The IACK keypad of claim 61 wherein the independent key regions are of
2 diamond shape, with arms directed between adjacent combination keys.

1 64. The IACK keypad of claim 59 wherein each pair of adjacent independent key
2 regions has three of said snap elements disposed along a line segment disposed midway
3 between the pair of independent key regions.

1 65. The IACK keypad of claim 64 wherein the three snap elements are equally
2 spaced along the line segment, with one directly between centers of the independent key
3 regions of the pair, and one at either end of the line segment, at an interstice between four
4 adjacent independent key regions.

1 66. The IACK keypad of claim 55 wherein the snap elements are of elastomer
2 integrally molded with and extending from a back surface of the cover.

1 67. The IACK keypad of claim 55 wherein the snap elements are molded of
2 silicone.

1 68. The IACK keypad of claim 55 wherein the snap elements are of frustoconical
2 shape.

1 69. The IACK keypad of claim 55 wherein the snap elements are arranged to
2 provide a substantially equal tactile feedback in response to activating both independent key
3 regions and combination key regions.

1 70. The IACK keypad of claim 55 wherein the snap elements are constructed and
2 arranged to require a substantially equal normal activation force for both independent key
3 regions and combination key regions.

1 71. An IACK keypad comprising
2 a substrate carrying an array of sense elements arranged to change state in response to
3 keypad operation; a flexible cover disposed above the substrate and having an exposed
4 surface defining an array of independent key regions, with combination key regions defined
5 in interstices between adjacent independent key regions; and
6 an array of discrete snap elements extending between the cover and the substrate and
7 spacing the cover from the substrate, the snap elements each located between two adjacent
8 independent key regions and adapted to resiliently collapse toward the substrate as a non-
9 linear response to local pressure against the exposed cover surface to provide tactile feedback
10 of keypad operation, the snap element each being symmetric in shape about an associated
11 axis perpendicular to the substrate and intersecting the cover between adjacent independent
12 key regions.

1 72. The IACK keypad of claim 71 wherein the snap elements are frustoconical in
2 shape.

1 73. The IACK keypad of claim 71 wherein each independent key grid space has at
2 least four corresponding, spaced-apart snap elements disposed at its periphery, with each
3 interstice between four adjacent snap elements corresponding to a key region.

1 74. The IACK keypad of claim 71 wherein the snap elements are of elastomer
2 integrally molded with and extending from a back surface of the cover.

1 75. The IACK keypad of claim 71 wherein the snap elements are arranged to
2 provide a substantially equal tactile feedback in response to pressure against both
3 independent key regions and combination key regions.

1 76. An IACK keypad comprising
2 a substantially planar substrate carrying an array of sense elements arranged to
3 change state in response to keypad operation;
4 a flexible cover disposed above the substrate and having an exposed surface defining
5 an array of key regions arranged in rows; and
6 at least one continuous, elongated snap element extending adjacent at least three key
7 regions of one row of key regions, between the cover and the substrate and spacing the cover
8 from the substrate, the snap element adapted to resiliently collapse as a non-linear response
9 to local pressure against the exposed cover surface to provide tactile feedback of keypad
10 operation.

1 77. The IACK keypad of claim 76 comprising multiple snap elements in the form
2 of elongated rails extending between adjacent rows of key regions.

1 78. The IACK keypad of claim 76 wherein the snap element comprises a rib
2 extending at an angle with respect to the plane of the substrate and configured to buckle in
3 response to local pressure against the exposed cover surface.

1 79. The IACK keypad of claim 78 wherein the angle is about 60 degrees.

1 80. An IACK keypad comprising
2 a substantially planar substrate carrying an array of sense elements arranged to
3 change state in response to keypad operation; and
4 a flexible cover disposed above the substrate and having
5 an exposed surface defining an array of independent key regions arranged in
6 rows and columns, with combination key regions between adjacent independent key regions,
7 and
8 a back surface facing the substrate and held away from the substrate by
9 collapsible snap elements therebetween, the back surface carrying an array of conductive
10 pills located beneath corresponding independent key regions;
11 wherein each conductive pill has a contact surface facing the substrate, the contact
12 surface having outer regions that slope away from the substrate.

1 81. The IACK keypad of claim 80 wherein the conductive pills are cross-shaped,
2 with arms extending toward multiple adjacent combination key regions, the arms of the
3 conductive pills comprising the sloping outer regions.

1 82. The IACK keypad of claim 80 wherein each conductive pill extends across the
2 back surface of the substrate toward an adjacent combination key region center a lateral
3 distance equal to between about 40 percent and 99 percent of a distance between the adjacent
4 combination key region center and a center of the independent key region corresponding to
5 the pill.

1 83. The IACK keypad of claim 82 wherein each conductive pill extends across the
2 back surface of the substrate toward an adjacent combination key region center a lateral
3 distance equal to between about 50 percent and 90 percent of a distance between the adjacent
4 combination key region center and a center of the independent key region corresponding to
5 the pill.

1 84. The IACK keypad of claim 83 wherein each conductive pill extends across the
2 back surface of the substrate toward an adjacent combination key region center a lateral
3 distance equal to between about 70 percent and 80 percent of a distance between the adjacent
4 combination key region center and a center of the independent key region corresponding to
5 the pill.

1 85. A method of interpreting IACK keypad input, the method comprising
2 sensing keypad input corresponding to a combined actuation of a plurality of
3 independent key regions of the keypad;
4 comparing the sensed input to defined sets of independent key inputs corresponding
5 to combination keys;
6 for sensed inputs found to correspond to a plurality of independent key regions
7 associated with a combination key, registering a combination key input; and,
8 for sensed inputs found not to correspond to any combination key, comparing the
9 sensed input to recorded custom chorded key associations; and,
10 for sensed inputs found to correspond to a recorded custom chorded key association,
11 registering a sequence of characters according to the corresponding chorded key association.

1 86. The method of claim 85 further including, for sensed inputs found not to
2 correspond to any combination key or to any recorded custom chorded key association,
3 generating a sequence of characters determined solely by the plurality of independent key
4 regions of the sensed input.

1 87. The method of claim 86 wherein the sequence of characters is generated by
2 arranging the independent key regions of the input according to a predetermined order.

1 88. The method of claim 85 further including, for sensed inputs found not to
2 correspond to any combination key or to any recorded custom chorded key association,
3 storing in readable memory an association between the sensed input and a selected string of
4 characters.

89. The method of claim 88 wherein the selected string of characters is defined by characters contemporaneously shown on a display when the input is sensed.

90. The method of claim 85 further including, for sensed inputs found not to correspond to any combination key,

comparing the sensed input to an input character last registered prior to the sensed input to determine whether the last registered character is among the plurality of independent key regions of the sensed input; and,

for last registered characters found to be among the plurality of independent key regions of the sensed input, deleting said last registered character.